(vii) Considerations and principles of soft tissue cover for the hand

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Abstract

There are a number of considerations to be accounted for when planning soft tissue cover for the hand. We not only have to think about skin closure but also other issues such as appearance, tendon cover and sensibility.

One way to approach this challenge is to prioritise the requirements for reconstruction. In the hand, function is paramount but even within this encompassing term there are different modalities to function, which need to be ordered in priority. The aesthetic appearance of the hand must also be a consideration as the hand is the second most cosmetically sensitive part of the body after the face. In reconstruction, the nature of the defect will also need to be defined as this can change the options available.

Keywords hand reconstruction; local flap; pedicle; skin graft

Introduction

Soft tissue cover in the hand presents a number of unique challenges related to the high functional and aesthetic demands associated with this complex anatomical structure. The hand is well vascularised, but soft tissue defects often result in exposure of tendon and bone. Planning cover for these defects should take into account not only the size of the defect to be covered but also how best to restore appearance and maintain function in a way that will be durable, taking into account also the potential for adherence and contracture formation as wounds heal.

Skin of the hand

Firstly we should consider the anatomy of the skin on the hand and how it interacts with surrounding structures. We have said that within the hand the main priority for reconstruction is function. The contribution of skin to the function of the hand, and how it interacts with underlying structures, must be understood in detail and this will allow us to comprehend how the planned reconstruction will either improve or, in some cases, hamper function.

The skin is a complex organ, which performs a number of functions. It acts as a semipermeable membrane, which behaves as a barrier to toxic materials and microbes and UV radiation. It also plays a role in thermoregulation, sensation and vitamin synthesis. The skin on the hand is designed with specialist function in mind and this design varies between locations on the hand. The volar and dorsal skin of the hand differs quite considerably and even skin on the volar aspect of the hand can vary dependant on location, for example the fingertip.

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Volar skin

The skin on the volar aspect of the hand is very specialised, differing in structure from skin in other parts of the body. This skin is known as glabrous skin from the Latin 'Glabor' which means hairless. Along with a lack of hair in the skin there are also no sebaceous glands present. The epidermis is also thicker; the ratio of thickness of the different layers of the epidermis is different to skin elsewhere. The epidermis is composed of four constant layers: the stratum basale, stratum spinosum, stratum granulosum and stratum corneum. A thicker stratum corneum and an additional layer, not normally seen in skin other than the palm and sole of feet, called the stratum lucidum is also present and this contributes to a thicker epidermis. This provides us with robust skin able to tolerate regular loading and friction, as is essential in the palm of the hand and the soles of the feet. This skin also contains a higher concentration of nerve endings responsible for the sensory functions of the hand.

Aside from its internal structure, the relationship of this skin with underlying structures is also important to its function. Adherence of the skin on the volar aspect of the hand to underlying rigid structures by means of the fascial bands is key to ensuring that the skin does not move over the deeper structures during the application of force thereby allowing greater efficiency in the transfer of force during function. This is more evident in the fingertip, where strong fibrous septae anchor the skin and palmar pulp to the underlying periosteum.

Dorsal skin

The dorsal skin does not have the specialist structure required by the volar skin. The skin is therefore structurally like skin on the rest of the arm. It is hair-bearing and mobile over the deeper structures, which is particularly useful over the dorsum of finger joints, allowing finger flexion to occur without any skin resistance.

Considerations for reconstruction

When planning reconstruction one must have an idea of the essential components that need to be present and also one should have made an accurate assessment of the nature of the defect to be reconstructed.

Structures

Our primary goal will be to restore function. Function in the hand requires a number of components to be present and these will vary dependant on whether the defect is dorsal or volar. The first component that must be achieved, regardless of where the defect is located, is wound closure. Other components that need to be considered are sensation, skin thickness, skin pliability and adherence to underlying tissues.

Following function the aesthetic appearance should also be taken into consideration, including such factors as colour match, hair-bearing status (hair bearing reconstruction is not ideal for volar skin) and cosmetic subunits.[1]

Defect

The defect should also be well defined to give an idea as to the components that need replacing and the healing potential of the wound. Aspects that one should document are as follows:

- Acute/Chronic wound
- Elective wound
- Injury wound
  - Blunt
    - any undermining?
  - Sharp
  - Thermal
- Full thickness/partial thickness wound
- Size of the defect
- Is the base of the wound well vascularised?
  - Exposed bone
  - Exposed tendon
  - Exposed metalwork

Methods of reconstruction

It would be foolhardy and arrogant to approach soft tissue defects of the hand without considering healing by secondary intention. The hand is a very vascular structure and has great healing potential. Quite large wounds, with exposed structures, are well recognised from experience with elective Dupuytren's surgery to heal up satisfactorily and in a reasonable time frame.[2] Finger tip injuries with amputation are also another good example, particularly in children where amputation of up to a half of the nail bed with exposed distal phalanx will heal by secondary intention giving, a good functional and cosmetic result.[3,4]

Methods of reconstruction are numerous but with our understanding of the structures of the skin in the area of the defect, the characteristics of the defect and the extent of the defect we should be able to narrow down our options to the one or two most appropriate choices. Options include the following:

Skin grafts: skin graft is skin that is harvested from an area of intact skin, or a donor site, and delivered to the recipient site with no intact vascular components. Vascular elements from the recipient bed then form new channels into the graft (neovascularisation) or join with residual vascular elements within the graft (inosculation) to provide nutrients to the graft to allow it to be viable. Skin graft come in two main forms and these are as follows.

Split thickness skin graft – here the graft contains a full thickness of epidermis along with a partial thickness of the dermis. Split thickness skin graft provides a reliable method of wound closure over a reasonably vascularised wound. Donor site morbidity is low and large-size grafts can be harvested from many parts of the body with relative ease. It is particularly useful in extensive burn injuries where a large graft size of may be required. The limitations, however may compromise function, as the grafts do tend to contract and this may inhibit movement. The graft will also adhere rigidly to underlying structures so not allowing pliability of skin and therefore not allow any stretch, once again restricting movement, particularly if over a joint. However this property can prove to be of benefit over the volar aspect of the finger tip. The graft is also not sensate and unlikely to neuratise. The resultant skin may also be fragile and therefore not appropriate at sites that need to absorb or transfer force.

Full thickness skin graft – In this case the graft contains the full thickness of both epidermis and dermis. Full thickness skin grafts provide good quality skin reconstruction with minimal secondary contracture. (Figure 1) The graft may also neuratise to allow some return of sensation.[5,6] It does however require a well vascularised bed and is limited by size with the graft, as it has to be small enough to allow the donor site to be closed primarily. Graft take is also not as reliable as a split thickness skin graft, as a greater distance for revascularisation is required with a thicker graft. Therefore any problem during the revascularisation phase such as haematoma or seroma formation may compromise the graft viability.

Flap reconstruction

A flap, unlike a skin graft, is tissue, which does not have to be skin alone but can also include fat, fascia, muscle and even bone if necessary, and can include any of these components in isolation. A flap also differs from a graft in that it brings with it intact vasculature to deliver nutrients to the tissues that are being moved, and it may contain complete vascular components, which can be surgically anastomosed with vessels at, or near, the recipient site. Flaps have the added benefit over grafts that the recipient bed does not have to be well vascularised to allow healing, therefore structures such as exposed bone and tendon can be covered, as well as foreign materials such as metal implants used for bone fixation or joint replacement.

Flaps can be categorised by the components that they contain, as follows:

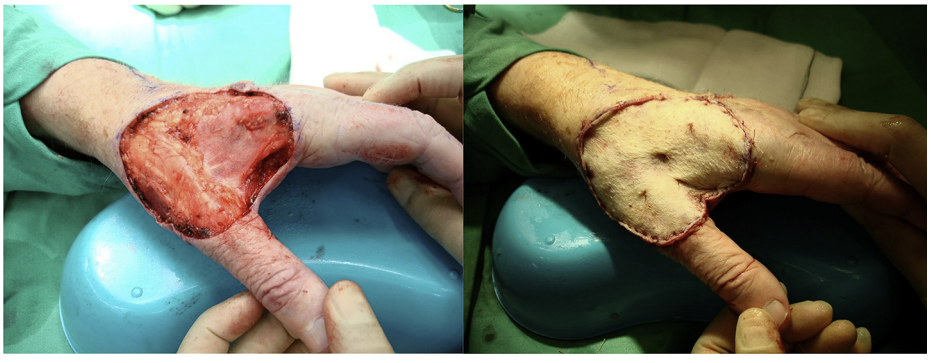

Figure 1 Full thickness skin graft used to close a defect to the dorsum of the 1st web.